TYPE B ACCIDENT INVESTIGATION BOARD REPORT OF THE DECEMBER 15, 1997, LEAKAGE OF WASTE CONTAINERS NEAR KINGMAN, ARIZONA

U.S. Department of Energy
Fernald Environmental Management Project

DISCLAIMER

This report is an independent product of the Type B Investigation Board appointed by G. Leah Dever, Manager, U.S. Department of Energy, Ohio Field Office.

The Board was appointed to perform a Type B Investigation of this incident and to prepare an investigation report in accordance with DOE Order 225.1A, Accident Investigations.

The discussion of facts, as determined by the Board, and the views expressed in the report do not assume and are not intended to establish the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

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OFFICIAL'S ACCEPTANCE STATEMENT

On December 22, 1997, I established a Type B Accident Investigation Board to investigate the leaking white metal boxes en route from the Fernald Environmental Management Project to the Nevada Test Site. The Board's responsibilities have been completed with respect to this investigation. The analysis, identification of direct, contributing, and root causes, and judgments of need reached during the investigation were performed in accordance with DOE Order 225.1A, Accident Investigations. I accept the findings of the Board and authorize the release of this report for general distribution.

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G. Leah Dever Date
Manager
Ohio Field Office

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ACRONYMS AND INITIALISMS

AEDO	Assistant Emergency Duty Officer
AL	U.S. Department of Energy, Albuquerque Operations Office
CAR	Corrective Action Report
CFR	Code of Federal Regulations
CGR	CGR Compacting, Inc.
CTR	Contract Technical Representative
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DP	U.S. Department of Energy, Defense Programs
EDO	Emergency Duty Officer
EH	DOE Office of Environment, Safety and Health
EM	DOE Office of Environmental Management
EOC	Emergency Operations Center
FEMP	Fernald Environmental Management Project
FDF	Fluor Daniel Fernald, Inc.
Hazmat	Hazardous Material
HAZWAT	Hazardous Waste Technician
KFD	Kingman Fire Department
LLRW	Low-Level Radioactive Waste
MEF	Material Evaluation Form
MVO	Motor Vehicle Operator
NCR	Nonconformance Report
NTS	Nevada Test Site
NV	U.S. Department of Energy, Nevada Operations Office
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ORPS	Occurrence Reporting and Processing System
QA	Quality Assurance
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RRA	Radiological Response Agency
SNL	Sandia National Laboratories/New Mexico
WMB	White Metal Box

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PROLOGUE

INTERPRETATION OF SIGNIFICANCE

This Type B Investigation Board was convened to underscore the programmatic impact of having boxes of low level waste leak during shipment; it was not convened as a result of the environmental safety and health significance of the event. The Department's overall efforts to restore the environment will require the transport of various waste types over a number of transportation routes, some which pass through communities. As such, the impact of container leakage during shipment on public confidence must be factored into any determination of performance expectations. In this case, the emphasis of management and programmatic oversight was incorrectly focused on the low hazard to the public and the environment, rather than the large potential impact on public confidence in the Department's efforts to safely restore the environment.

The Department must carefully weigh a response to this specific event. It is clear that strong tight containers are required for this low level waste and that these containers must maintain their integrity under normal operations including transportation. However, it is also clear that a balance must be struck between cost and risk reduction to complete the environmental restoration objectives.

The Department should commit to performing more rigorous oversight of waste management programs, and heighten the level of appreciation for the programmatic impact associated with a single leaking container. As evidenced in this investigation, there were a number of opportunities for the Department and its contractors to address the issues which led to the multiple box failures that occurred in December 1997. These opportunities were addressed with a level of rigor appropriate for the potential environmental, safety and health risk, but not appropriate for the programmatic and operational impact. If the precursor events had been held to a higher standard commensurate with the programmatic impact, there would have been a greater likelihood that the issues would have been addressed before an en route leak occurred.

I would like to note that this report was made successful by a number of factors including:

- The strong, unwavering support by the Manager of the Ohio Field Office and the Director of the Fernald Environmental Management Project, Ohio Field Office;
- The performance of the Board members, technical analysts, and consultants assembled from throughout the complex, including representatives from the Nevada, Albuquerque and Idaho Operations Offices, with proven experience and expertise in the areas of low level waste management;
- The counsel and support provided by the Accident Investigation Program Manager, Office of Oversight, Office of Environmental Safety and Health (EH-2);
- The openness of information exchange and documentation provided by Fluor Daniel Fernald personnel in support of the investigation.

As a process, the execution of Type B Investigations, in accordance with DOE guidance, is a very structured and disciplined but resource intensive process which should not be undertaken without careful consideration of all factors involved. This event clearly warranted the performance of a Type B Investigation given the large programmatic costs that have occurred and will continue for some time.

EXECUTIVE SUMMARY

On December 15, 1997, the driver of a truck containing seven containers of low level radioactive waste noticed that the trailer was leaking as he exited from Interstate Highway 40 near Kingman, Arizona. The driver notified local authorities, the Assistant Emergency Duty Officer at Fernald Environmental Management Project (the shipper), and his company of the leak. Local authorities responded to the scene, as did representatives of the State of Arizona. The DOE dispatched a Radiological Assistance Program Team and a support team from Fernald Environmental Management Project to support the Incident Command.

No radioactive contaminant was detected by the responders and they determined that the leaking liquid was not hazardous to the health and safety of the public or damaging to the environment. The Fernald Environmental Management Project Support Team took custody of the shipment, controlled the leaks, and returned the low level radioactive waste to Fernald on December 21, 1997. On December 22, 1997, G. Leah Dever, Manager, Ohio Field Office, appointed a Type B Accident Investigation Board to investigate the event in accordance with DOE Order 225.1A, Accident Investigations.

The Board concluded that free liquid in the containers leaked onto the trailer floor, and later out of the trailer when stress fractures (cracks) in two of the shipping containers were widened by the protracted vibration and wear associated with highway transport. The Board further concluded that the initial stress fractures occurred as a result of routine handling of the containers during loading and staging for shipment at Fernald and that the integrity of the other containers now staged for shipment at Fernald should be examined for similar stress fractures. Review of the contractor procurement process revealed that the design weakness that led to the stress fractures was caused by a series of events, including Fluor Daniel Fernald's failure: to specify appropriate design requirements in a contract with the container manufacturer; to adequately oversee the design modifications made by the manufacturer; and to conduct appropriate tests of the containers.

The presence of significant quantities of free liquid in the containers was unexpected, since a number of actions specifically intended to eliminate free liquid are routinely performed before shipping. The Board reviewed the procedures that specify these actions and their implementation at Fernald. This review indicated that the amount of liquid that might separate from the material during shipping and handling was not properly analyzed after earlier shipments were identified as having had free liquid form during shipment. In addition, while sorbent material is routinely added to eliminate any free liquid that might appear, the properties of the sorbent used were misunderstood and, therefore, the sorbent material did not serve the intended purpose.

The Board determined that the root cause of the event was that the Fluor Daniel Fernald contracting process did not deliver a strong, tight container as required by contract specifications. Four contributing causes were also identified:

- Continued use of the containers for shipping after design flaws were identified as a result of earlier container failures;
- Lack of understanding of the properties of the waste stream (i.e., that a quantity of free liquid

could form during transportation);

- **!** A lack of formality and rigor in contractor oversight between DOE Fernald and DOE Nevada; and,
- **!** A failure to provide the appropriate attention and oversight to these shipments of low level radioactive waste because of the relatively low potential threat to health and safety.

The major conclusions of the Board and the associated Judgements of Need are presented in Table ES-1 below. Specific corrective actions were not addressed by the Board.

Table ES-1. Conclusions and Judgements of Need

Conclusions	Judgements of Need
All the White Metal Box designs on hand have the same design features as the failed boxes and/or have not been adequately tested to determine whether they might experience the same failure.	FDF needs to ensure all White Metal Box designs meet performance criteria and receive DOE approval prior to shipping.
None of the White Metal Boxes delivered and accepted were of the same design as the metal box supplied by CGR for testing prior to contract award, nor was configuration control of subsequent design changes sufficiently rigorous to ensure that delivered containers met all requirements and operational criteria, such as stacking.	FDF needs to improve the procurement process to ensure program operation requirements are met. Special emphasis should be placed on interface with technical/support functions.
Dicalite is not a sufficiently effective sorbent to be used as described in procedure PT-0007.	FDF needs to understand the physical properties of the high moisture content waste streams and the effects of sorbents in packaging and transportation.
Although the FEMP Support Team efforts during recovery actions were effective, planning and preparation for the dispatch of the FEMP Support Team was insufficient to ensure consistent performance if deployed in response to future incidents.	FDF needs to develop more comprehensive formal plans for deploying Support Teams at significant distances from FEMP. In addition to identifying a clear mission statement, special emphasis should be placed on travel arrangements, suitable equipment sets, training and certification for team members, and possible assumptions of liability following certain Team actions.

Conclusions	Judgements of Need
DOE-FEMP did not adequately review the FDF procurement of the White Metal Box, did not assure effective validation of contractor corrective action closure, used multiple systems to track the status of concerns, and did not have a program to identify programmatic trends based on all information available.	DOE-FEMP and DOE Ohio need to improve their contractor oversight, and FDF needs to improve their self assessment and quality assurance programs. Areas for improvement include conducting formal program audits, developing a programmatic trending and tracking capability with access to all applicable status information, and continuing to monitor ongoing corrective action commitments.
DOE roles and responsibilities regarding the interface between DOE-FEMP and DOE Nevada are not clearly defined in the areas of notification and follow up to FEMP issues identified by NTS when shipments are unloaded.	DOE-FEMP, DOE Ohio and DOE Nevada need to clarify the roles and responsibilities for notification, validation and closeout of corrective actions, including root cause analysis.
The sensitivity of a leaking low level radioactive waste shipment was not properly factored into the analysis for these shipments to NTS even though the health and safety of the public and the environment were not harmed, since the released liquid was non-hazardous and not harmful to the environment.	The Office of the Assistant Secretary for Environmental Management, in conjunction with DOE Ohio, DOE Nevada, and other affected parties, needs to establish criteria for transportation of low level waste so that programmatic and operational needs can be properly assessed.

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Figure 1-1 A Typical White Metal Box During Handling

1.0 INTRODUCTION

1.1 BACKGROUND

On December 15, 1997, a shipment of waste containers (White Metal Boxes) containing depleted and slightly enriched uranium residues was observed to be leaking fluid during a routine visual inspection of the truck near Kingman, Arizona. This shipment of material from the Fernald Environmental Management Project was en route to Nevada Test Site for disposal. The driver of the truck promptly reported the leak to local authorities and the cognizant Department of Energy officials. A rapid response from the Mojave County Sheriff's Department, the Kingman Fire Department, the Arizona State Police, and a Department of Energy Radiological Assistance Program team established control of the site and subsequently determined that the leak presented no radiological hazard. There was no significant impact to the health and safety of the personnel involved in this occurrence or the public, nor was there any significant damage to the environment.

In view of the potential programmatic consequences of further leaks during shipments of low level radioactive waste, G. Leah Dever, Manager, Ohio Field Office, appointed a Type B Accident Investigation Board on December 22, 1997, to investigate the event in accordance with DOE Order 225.1A, Accident Investigations (See Appendix A).

1.2 THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

The Fernald Environmental Management Project (FEMP) is an area of 1,050 acres located about 18 miles northwest of Cincinnati, Ohio. Between 1953 and 1989, the facility produced uranium metal products for the nation's defense programs. These products were used in production reactors to make plutonium and tritium at other Department of Energy (DOE) sites. In July 1989, the DOE suspended uranium metal production to focus resources on environmental restoration. In December 1989, the U.S. Environmental Protection Agency added the Fernald site to the agency's National Priorities List of federal facilities in need of remediation. In February 1991, the Department of Energy announced its intention to formally end Fernald's production mission. Closure became effective in June 1991. Currently, Fluor Daniel Fernald, Inc. (FDF), formerly known as the Fernald Environmental Restoration Management Corporation, is managing all cleanup activities at the Fernald site under a contract with the DOE. FDF is a wholly-owned subsidiary of Fluor Daniel, Inc. of Irvine, California.

Waste at the Fernald site falls generally into three categories: low-level radioactive waste, hazardous waste, and mixed (radioactive and hazardous) waste. The waste is stored in six pits, three silos, and thousands of 55-gallon drums and other containers. The treatment, storage, and disposal of hazardous waste must meet requirements of the Resource Conservation and

Recovery Act of 1976 (RCRA) and its subsequent amendments. Characterization and analysis of all waste material at the Fernald site is necessary to determine the precise nature, quantity, and location of each kind of waste, and how each should be handled under RCRA. Ongoing waste management activities include sampling suspect RCRA materials, overpacking deteriorated drums to prevent escape of radioactive and hazardous materials into the environment, and proper storage and handling of RCRA regulated waste.

Low level radioactive waste like that involved in the Kingman incident is shipped to Nevada Test Site (NTS) for disposal. Shipments are made in metal waste containers known as White Metal Boxes that are intended to meet the Department of Transportation (DOT) requirements specified in Chapter 49, Code of Federal Regulations, and other applicable federal, state, and local laws and regulations. These waste containers, in a half-height and a full-height configuration, are procured for FEMP use through a FDF subcontract with CGR Compacting, Inc.

Low level radioactive waste is prepared for shipping by placing it (along with material intended to sorb free liquids if any are present) into a White Metal Box. These White Metal Boxes, when loaded, may be staged at FEMP for periods of a few weeks before being shipped to NTS. Upon arrival at NTS, the White Metal Boxes are placed in prepared and approved burial pits. Each of these burial pits is covered by earth when the authorized number of waste containers have been placed within it.

1.3 SCOPE, CONDUCT, AND METHODOLOGY

The Board commenced its investigation on January 5, 1998, completed the investigation on January 27, 1998, and submitted its findings to the Manager, Ohio Field Office, on January 29, 1998. Following consideration of comments from the Approving Official, the revised Report was submitted by the Board on February 2, 1998.

The scope of the Board's investigation was to determine the event's cause by reviewing and analyzing the circumstances surrounding the incident. The scope also included the evaluation of the adequacy of the DOE and contractor's safety management system and work control practices. Of particular interest within this overall scope was the specification and contract for the White Metal Boxes; the subsequent management of that contract; operational matters related to packing, storage, handling of low level radioactive wastes at FEMP; transportation of this waste material from FEMP to NTS; and the emergency response and recovery actions taken in response to this event.

The scope specifically excluded associated issues not directly related to the identification of the causes of this event, such as waste transportation throughout the DOE, internal processes in other Emergency Operations Centers that were not related to the causes of this event, investigations of the use of similar waste containers by other DOE activities, and selection of shipping routes for waste shipments in general.

The **purposes** of this investigation were to determine the causes of the event, including deficiencies, if any, in safety management systems, and to assist the DOE in understanding lessons learned to promote safety improvement and to reduce the potential for similar events.

The Board conducted its investigation using the following **methodology**:

- Facts relevant to the event were gathered through interviews and through document and evidence reviews.
- Tests were conducted to attempt to reproduce the separation of water from other waste

material that was observed in one of the leaking boxes.

- Laboratory evaluations were conducted to determine whether the portions of the boxes near the failure point conformed to specification and to attempt to identify the failure process resulting in the observed metal cracking.
- Event and causal factors charting[1], along with barrier analysis[2] and change analysis[3], was used to provide supportive correlation and identification of the event's causes.
- Based on analysis of the data, judgements of need for corrective actions to prevent recurrence were developed.

[1] Charting depicts the logical sequence of events and conditions (causal factors) that allowed the events to occur.

[2] Barrier analysis reviews hazards, the targets (people or objects) of the hazards, and the controls or barriers that management controls systems put in place to separate the hazards from the targets. Barriers may be administrative, physical, or supervisory/management.

[3] Change analysis is a schematic approach that examines barrier/control failurs resulting from planned or unplanned changes in a system.

2.0 FACTS AND ANALYSIS

2.1 EVENT DESCRIPTION AND CHRONOLOGY

2.1.1 Event Description

The event occurred as a shipment of seven White Metal Boxes containing low level radioactive waste was en route from FEMP to NTS. The truck driver identified the leakage of an unknown liquid from his trailer as he was preparing for a routine stop near Kingman, Arizona. There had been no observable leak at his previous inspection stop, approximately 370 miles before. He parked the truck adjacent to the Petro Truck Stop at Exit 66 of Interstate Highway 40 and notified FDF at 1654 Eastern Standard Time.[4]

Figure 2-1 The Leaking Trailer

2.1.2 Chronology of Events

A chronology of events including precursor events, critical points during the event and event response, and the subsequent recovery of the leaking shipment is found in Appendix B.

2.1.3 Event Response

The FDF Assistant Emergency Duty Officer contacted the FDF Emergency Duty Officer immediately after receiving notification of the leaking trailer at Kingman, Arizona. After review of the FEMP Transportation Emergency Plan, it was determined that the criteria of an Operational Emergency had been met and, at 1705, the event was categorized as an Transportation Operational Emergency. An Offsite Transportation Operational Emergency is defined as a "transportation incident involving a shipment of hazardous or radiological material originating from the FEMP in which the integrity of the shipment is in doubt or cannot be readily determined." The Emergency Duty Officer directed activation of the FEMP Emergency Response Organization.

A Deputy from the Mojave County Sheriff's Department was the first responder to the 911 call initiated by the truck driver. This Deputy established a 350 foot exclusion zone around the truck and notified the Kingman Fire Department at 1720 that a trailer containing low level radioactive waste was leaking. Arriving at the scene at 1741, Fire Department responders assured that an appropriate exclusion zone had been designated around the trailer and established a Hazardous Material Command Post. With the concurrence of the Sheriff's Deputy, the Kingman Fire Department assumed Incident Command at the scene. It was ascertained that resources of the State Radiological Response Agencies were en route.

The FEMP Emergency Operations Center (EOC) established communications with the On-

[4] All times will be expressed in Eastern Standard Time (EST) unless other wise indicated.

Scene Incident Command at 1750. The FEMP Emergency Operations Center provided additional information regarding the contents of the waste containers to supplement that contained in the shipping documentation. Shortly after this call, the Incident Commander reduced the exclusion zone around the trailer from 350 feet to 150 feet, which allowed the Exit 66 exit ramp from westbound Interstate Highway 40 to be reopened.

The FEMP EOC was declared operational at 1751. By 1803, A DOE Radiological Assistance Program Team had been requested by the FEMP EOC. Confirmation of team deployment was forwarded to the Kingman Incident Commander by approximately 1900. By 1930, Kingman Fire Department personnel had entered the exclusion zone and measured no radiological readings above background. It should be noted that the equipment available to the Kingman HAZMAT Team (a Geiger-Meuller dose rate survey meter) was not sensitive enough to detect the low level of radiation to be anticipated from a leak from a shipment of this type. The FEMP EOC advised the Incident Command that the available instruments were not sufficiently sensitive. In light of this, the Kingman Fire Department and personnel from the State Radiological Response Agencies assumed a monitoring and observation posture awaiting the arrival of the DOE Radiological Assistance Program Team. The Incident Commander was also advised that a team from the FEMP would be deployed to the site to support his operations.

At 2250, the DOE Radiological Assistance Program Team arrived at the scene and conferred with the Incident Command and other supporting agencies. The DOE Radiological Assistance Program Team surveyed the driver and the personnel and equipment on-scene from the Kingman Fire Department. No radioactive contamination was detected. The Radiological Assistance Program Team then conducted a survey of the truck and exclusion zone. This survey indicated no activity above background levels for alpha, beta, or gamma radiation. The instruments available to the Radiological Assistance Program Team included alpha and beta/gamma survey instruments that had the sensitivity necessary to conduct an effective survey for leakage of low level radioactive waste.

At 0001, December 16, 1997, the Radiological Assistance Program Team opened the trailer. An unexpected and unidentified odor was detected and the Team exited the area. Discussions with the FEMP EOC resolved concerns regarding the normal odor of wet sludge and, at 0005, the Team resumed their examination of the trailer contents. A survey of the interior of the trailer disclosed no evidence of radioactive contamination. Visual inspection of the trailer and boxes revealed a leak of liquid and a fine, sand-like material on the floor of the truck, apparently leaking from the rear-most waste container on the trailer.

At 0108, the Incident Commander, with the concurrence of the support elements on the scene, reduced the exclusion zone to the perimeter of the truck. The Incident Commander also decided to return control of the truck to the driver, allow all other on-scene personnel to depart the area, and to meet with the FEMP Support Team at 1200. These decisions were communicated to the FEMP EOC and control of the trailer was returned to the driver with instructions. All emergency response elements left the scene by 0155. The FEMP EOC also suspended operations for the night.

At 0530, the FEMP Support Team arrived at the event scene and received an update from the driver. The Team confirmed previous radiological readings, conducted external surveys, and, based on information provided by the driver about the leaking box, proceeded to a local hardware store to purchase materials needed to inspect the boxes further (crowbars, hammers etc. to remove shoring).

At 1230, the Incident Commander conferred with the State On-Scene Coordinator, the DOE Radiological Assistance Program Team, and the FEMP Support Team. The Incident Commander declared the emergency response terminated and turned the event scene over to the FEMP Support Team.

In summary, the FEMP EOC was fully staffed and operational 57 minutes after notification of the event. Notification of the DOE Headquarters Watch Office was made within 15 minutes of declaration of an Operational Emergency. Notifications to all appropriate local, State and Federal agencies were made within 30 minutes of the event being identified as an emergency. DOE Radiological Assistance Program (RAP) Team support was requested within 30 minutes of the activation of the FEMP EOC. The carrier notified the Environmental Protection Agency National Response Center and the State of Arizona. The critical DOE notifications to support the emergency response were made (See Appendix C). Also, the Bechtel Nevada Disposal Operations Manager was contacted by 1800 by the FEMP EOC to determine the status of other loads en route and the status of the shipments received. Attempts were made to contact the drivers of the other shipments en route and advise them to inspect their loads.

Interviews with the local and State emergency responders indicate a very high satisfaction with the level of response and support provided by the DOE. In addition, the Kingman Assistant Fire Chief and the State On-Scene Coordinator had attended DOE sponsored training for "Radiological Emergency First Responders" in September, 1997. Both individuals indicated that the training was very beneficial in identifying the low levels of radioactivity of Fernald shipments as well as reducing the "stress" level of this incident.

The FEMP EOC had an incomplete and out of date Carrier Emergency Response Plan. FDF Traffic Management had a complete but outdated Carrier Emergency Response Plan. This caused some uncertainty regarding the notifications to be made by the carrier.

The FEMP Transportation Emergency Plan was updated in July 1997 after completion of a Transportation Emergency Exercise in May 1997. The FEMP has deployed personnel to support On-Scene Incident Commanders in the past, however, the FEMP plan does not address the roles and responsibilities or necessary procedures to deploy personnel. Administrative requirements for deployment (airline ticketing, equipment selection and pick-up) were made "ad hoc". The FEMP Support Team departed on schedule, however the Radiological Control Technician and his equipment arrived at the airport at the last minute prior to departure.

2.1.4 Investigation Readiness

FDF and DOE-FEMP took prompt, effective action following the event to collect evidence and prepare for the investigation. It was not practical to preserve the scene of the event, or rather the scene of the leak discovery. Evidence was collected from the scene in the form of expert observation, photographs, and instrument measurements. Samples of the liquid leaking from the truck were collected and the condition of the leaking containers was ascertained and recorded. The leaking containers were identified and returned to FEMP for testing and evaluation. Upon arrival, photographs were taken of the waste material packed in the containers, the contents were offloaded into drums from which subsequent samples could be taken, and the damaged portions of the containers were supplied to FDF and to the Board for analysis. Key documentary evidence in the form of log books and other related documents were collected and supplied to the Board to support its investigation. The investigation readiness of FDF and DOE-FEMP met the requirements of

DOE Order 225.1A, Accident Investigations.

2.1.5 Recovery of the Leaking Containers and Subsequent Evaluation

Figure 2-2 Leaking Containers Within a Plastic Overwrap

On the evening of December 15, the FEMP EOC Recovery Team was designated by the FEMP Deputy Emergency Director. The focus of this team's effort throughout Monday the 15th and Tuesday the 16th was on returning the shipment to a strong, tight configuration and proceeding on to the Nevada Test Site. The organization was in contact with the Bechtel Nevada Disposal Operations Manager identifying what resources his organization could provide if assistance at the Kingman scene should be necessary. Conversations with the carrier indicated that they would assume no liability for recovery because the incident occurred through no fault of their driver. FDF Traffic Management personnel were not present for recovery planning on Monday evening because they are not a standing member of the FDF emergency response organization.

The FEMP Support Team deployed with the intent to provide technical assistance to the On-Scene Incident Command specific to the shipment. However, when the Support Team arrived at the event scene, the Incident Command had determined that no emergency condition existed and returned control of the shipment to the carrier. At 1230 on December 16, 1997, the Kingman Fire Department (Incident Command), the Arizona Department of Public Safety (State On-Scene Coordinator), the DOE Radiological Assistance Program Team, and the FEMP Support Team determined that no hazardous material release had occurred and the FEMP Support Team assumed control of the scene. No citation was issued by the Arizona Department of Public Safety to the carrier. At this time, the FEMP Support Team assumed a recovery role at the event scene. By 1400, local and State responders as well as the DOE Radiological Assistance Program Team had departed the scene.

On Tuesday, December 16, attempts were made to use a field expedient patch of epoxy on the White Metal Box at the rear of the trailer that had been identified as a leaker. Alternate plans for recovery of the shipment were still being developed at the FEMP by the recovery organization that included use of NTS assets or use of an emergency response contractor.

On December 17, 1997, after it was determined that there were additional leaks on the shipment, it was decided to employ an emergency response contractor and return the shipment to FEMP. A Pan Trailer (a trailer with a liquid tight inner lining) was requested from the Tri-State/Trism Motor Carrier on the afternoon of December 17. The containers that were still leaking were packaged in a plastic overwrap and loaded onto the Pan Trailer. The FEMP Support Team surveyed the original trailer bed and the White Metal Boxes for removable contamination and did not detect any release of radioactivity.

The shipment departed Kingman, Arizona, on Friday, December 19, and arrived at the FEMP on Sunday, December 21, 1997 at 1310. On Monday, December 22, 1997, the seven waste containers were unloaded and placed in Building 30A. The waste containers that leaked (483004 and 483141) were weighed. Number 483141 had lost 24 pounds of weight and Number 483004 had lost 207 pounds. (The original gross weights were 5,590 and 5,644 pounds, respectively, well below the maximum allowed gross weight of 9,000 pounds.)

After weighing, all seven waste containers were examined using real time radiography. While the other containers from the shipment showed no free liquid, Number 483004 showed evidence of liquid on top of the waste. Containers 483004 and 483141 were moved to Building 71 where they were opened. Visual examination confirmed that free liquid was present in Number 483004, but not Number 483141. The waste was removed from both boxes and placed into drums.

A calculation was performed to determine whether the free liquid present in Number 483004 exceeded the NTS Waste Acceptance Criteria of 1% free liquid. Using the assumption that the density of the liquid was that of water and neglecting the possible loss of Dicalite for conservatism, the 207 pound weight loss equated to 24.9 gallons. The NTS criterion for this waste volume under these assumptions is approximately 7 gallons. In addition, observation of the contents of 483004 after opening revealed more free liquid than would be allowed by the NTS requirement remained in the container on top of the waste, even after the loss of 207 pounds.

After unloading the waste, samples of both of the failed areas of container 483141 were removed. One was sent to the manufacturer for analysis. Later, the Board had the other failed area of 483141 sent to Sandia National Laboratories/New Mexico for independent analysis. The results from the analysis of the sample of 483141 provided to Sandia National Laboratories/New Mexico are discussed below. The results of the manufacturer's analysis of the other sample were unavailable in time to be evaluated by the Board.

Figure 2-5 One of the Cracked Areas on Container 483141

Figure 2-3 Box 483004 After Return to the FEMP

Figure 2-4 Box 483141 After Return to the FEMP

Sandia National Laboratories/New Mexico Laboratory Evaluation

The area immediately surrounding one of the failures on container 483141 was sent to Sandia National Laboratories/New Mexico for analysis. The Laboratory performed stress and metallurgical analyses on the waste container design and materials.

Figure 2-6 Loaded Container Showing Indications of Paint Cracking

In revision B of their report dated January 16, 1998, Sandia National Laboratories/New Mexico reported the following conclusions concerning the stress analysis.

- The static load of stacking one 6,000 pound container on top of a container loaded with 4,800 pounds of material (a common practice at FEMP) will cause yielding in the region around the end of the center runner (see Figure 2-6). The Sandia report goes on to state that adding a slight (2g) dynamic effect while stacking the top box is enough to cause failure.

- If two containers weighing 6,000 pounds each are stacked on top of a container loaded with 4,800 pounds of material, the bottom container will fail, even if no dynamic loading is experienced.

- A loaded container with no other containers stacked on it would be unlikely to experience structural failure, unless a dynamic load of 4g or greater were applied.

Results of the metallurgical analysis performed on one of the failure points of container 483141 may be summarized as follows.

- The materials used to construct the container met the American Society of Testing and Materials chemical specifications, exhibited microstructures and hardnesses consistent with expectations, and exhibited sound welds. There was no evidence that materials or welding deficiencies were the primary cause of failure of the container.

- The preponderance of evidence indicates that the primary crack resulted from combined bending and shear stresses that exceeded the yield and ultimate strength of the material, resulting in ductile overload failure.

- Stress corrosion crack growth occurred subsequent to initial crack formation. This growth may have occurred during storage, transport, or both.

- The vibrations and cyclic loads experienced during transportation caused the mating crack surfaces to repeatedly rub over one another, resulting in wear and the effective widening of the crack to the point were leakage occurred.

Examination of Other Loaded Containers

Observations of other loaded containers were made at NTS and FEMP. A member of the FEMP Support Team that responded to the event scene subsequently had the opportunity to observe additional cracked waste containers from FEMP at NTS. Each container crack was observed to be consistent with the cracks observed in the two failed containers at Kingman, Arizona. In addition, the Support Team member briefly examined other FEMP waste containers present at NTS. The Support Team member estimated that more than 10% of the containers available for examination exhibited paint cracks or other signs of stress in the metal near the end of the center runner.

The Board examined a number of containers stacked and awaiting shipment at FEMP. Loaded waste containers stacked in Plant 6 were examined. These containers contain uranium materials awaiting shipment to British Nuclear Fuels, Limited. Many of these exhibited cracking and spalling of paint and inward displacement of the base plate at the end of the center runner. In addition, a number of loaded waste containers awaiting shipment to NTS were examined in Building 30A. Paint cracking and rust was visible in approximately 1/3 of these containers at the ends of the center runner. A typical observation is shown in Figure 2-6.

Free Liquid in the Waste Containers

The procedures detailed in Section 2.2.2 are intended to preclude free liquids in shipments to NTS. Both DOE and FDF believed them to be effective. However, free liquids have been observed to form under normal handling and shipping conditions.

Also, samples of the waste from the leaking White Metal Boxes and other waste types were taken to perform further laboratory analyses. Moisture content of these samples ranged from 7.7% to 65.6%. This range of moisture content is representative of typical conditions of waste when loaded into White Metal Boxes. These tests were designed to determine whether free liquid would disassociate from the waste if it were shaken, as it is during transportation. No free liquid was observed in the samples prior to shaking. The 26 samples were shaken for 15 hours. The analyst reported a few of the samples had free liquid when the samples were shaking, but did not note how many. The samples were allowed to rest for 120 minutes; at that time 17 samples had developed free liquid.

Most of the interviewed operators at FEMP believed that the sorbent material used, Dicalite, is not consistently effective on high moisture content wastes and that this opinion has been communicated to management. The Board reviewed the technical basis for the continued use of Dicalite as a sorbent material. The manufacturer's specification for the two available forms of Dicalite indicate that the material should sorb either 2.1 to 2.5 or 2.2 to 2.6 pounds of water per pound of Dicalite, depending on the form used. However, tests conducted by FDF in 1995 indicated that Dicalite and a section of RadPad could sorb up to 12 times its weight in water. Further, during interviews, the originator of the data stated his belief that 1 pound of Dicalite could sorb 2 gallons (approximately 16 pounds) of water. The analysis used in the FDF test and the results of that test were recorded informally on a page of a daily calendar, a copy of which was provided to the Board. An undated spreadsheet was provided to the Board as the basis for Table 4, Procedure PT-0007. This Table is used to determine the amount of sorbent to use. This spreadsheet is based on the assumption that one pound of Dicalite will sorb 16 pounds of water. No record of any tests conducted by FDF on other sorbent materials, such as RadSorb and

Water Works, was provided to the Board.

2.2 PHYSICAL HAZARDS, CONTROLS, AND RELATED FACTORS

2.2.1 Physical Hazards

The primary physical hazard related to transportation of low level radioactive wastes such as those involved in this event is a major leak of radioactive materials. The waste being shipped has a very low specific activity, and therefore substantial quantities are required to produce significant contamination. In addition to this hazard, FEMP waste shipments to NTS must meet NTS Waste Acceptance Criteria, including the requirement that there be no more than 1% free liquid present.

2.2.2 Controls to Mitigate the Physical Hazards

The FEMP has identified several partially redundant controls intended to prevent the leakage of radioactive material from low level radioactive waste shipments such as these and to meet the NTS criteria. Reducing or eliminating the free liquids in conformance with the NTS criteria also acts to somewhat mitigate the consequences of a loss of container integrity (due to the high viscosity of the non-liquid portion of the waste streams that feed the waste shipments). Controls specified for FEMP low level radioactive waste shipments to NTS include:

- Packaging the low level radioactive waste in a strong tight container able to maintain its integrity during normal loading, storing, and shipping operations;
- Eliminating, in so far as possible, free liquids from the container by accepting for loading only waste material with a limited amount of free liquid;
- Using a sorbent material to eliminate any free liquids that might otherwise be present; and,
- Using real time radiography after loading to detect the presence of any free liquid that may be present notwithstanding the material screening process and the addition of sorbent material.

Shipping Container Specifications and Procurement

The FEMP has historically shipped low-level waste off site for disposal using metal containers. The standard box in use is a 4' x 4' x 7' box referred to as a White Metal Box. As the contract with the supplier of the White Metal Boxes was coming to an end in 1995, FDF initiated a Request for Proposal for new boxes on April 10, 1995.[5] Container specifications in the Request For Proposal required a container that met Department of Transportation (DOT) criteria for a Strong-Tight Packaging (container) of metal construction, having a rated capacity of 9,000 pounds gross weight. The containers were to be capable of containing solid material of various particle sizes. The containers, including lids, were to be constructed of low carbon, hot rolled steel of no less than 12 gauge. The bottom of each container was to be equipped with no less than three 3-inch "I" beam runners (welded from the outside). However, FDF Traffic Management personnel

[5] In January 1995, there was an incident of leakage from one of the White Metal Boxes. This quality problem was noted and factored in to the design specifications for the White Metal Boxes in the new procurement.

were not part of the contract review team to ensure the White Metal Box design met Department of Transportation requirements.[6]

In addition, testing requirements for the containers were included in the Statement of Work of the Request For Proposal. These tests include, but are not limited to, Water Spray Test, Drop Test, Compression Test, Penetration Test, Vibration Test, and Bottom Lift Test. An alternate compression test to the 49 CFR test was specified. An additional Water Test was also specified.

The Request For Proposal was issued to sixteen offerors, both large and small businesses.

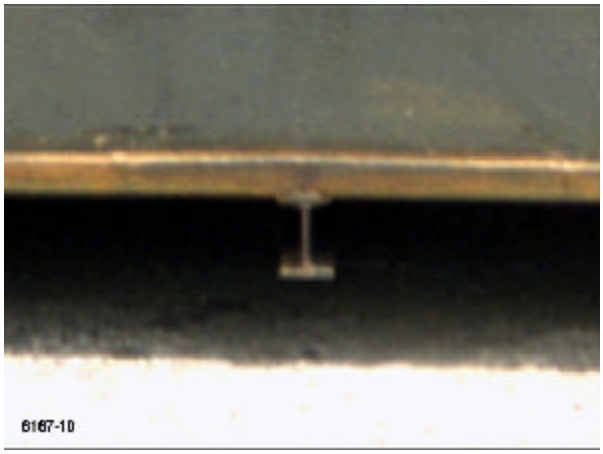

Figure 2-7 The Metal Container Tested

Figure 2-8 Closeup of the Center Runner Area on the Metal Container Tested

Nine proposals were received on May 5, 1995. The evaluation included performing the required tests against sample containers supplied by CGR Compacting, Inc. (CGR). (CGR was the lowest qualified bidder). The sample containers successfully completed all the required tests. CGR noted that 11 gauge steel was required to pass the specific vibration test, rather than the minimum of 12 gauge steel required by the Request For Proposal. Pictures taken during the testing of the CGR samples show the runners flush with the side walls of the container (See Figures 2-7 and 2-8).

Upon completion of the solicitation process and the conduct of a vendor Pre-Award Quality Assurance Site Survey, the contract (P.O. 95MB004830) was awarded to CGR on August 30, 1995. The contract, however, contained the same minimum technical specifications which were in the Request for Proposal, without amending them to reflect the container that was actually proposed. The same broad, performance-based specifications from the Request for Proposal were included in the contract. The single, low-detail drawing from CGR's proposal was added as Attachment IV to Section J of the contract. The contract also specified that the container and lid design were to be tested at least annually to show compliance with specified tests and requirements orginally contained in the Request for Proposal.

No breeches of the physical container and no leakage of material was reported with the original container design. However, between October 11, 1995 and April 9, 1997, FDF issued four contract modifications. Modification 4, dated April 9, 1997, significantly

[6] Additional container specifications are incorporated in the subcontract but not listed here.

changed the design of the container lid, the reinforcement around the top of the container, the vertical reinforcement in the corners, and also changed the base metal to the thinner 12 gauge. Although the Drop Test and the Compression Test were performed on the new design, none of the other tests required of the original design, including the Vibration Test, were performed. The manufacturer's written reasons for not running these tests were accepted by FDF. The annual testing specified in the contract was never performed.

On May 21, 1997, FDF was notified by Bechtel Nevada that White Metal Box Number 482403 built under Modification 4 was discovered to have leaked material from the box onto the trailer floor upon receipt at the NTS. Modification 5 returned the thickness of the base plate metal to 11 gauge steel. Again, no testing of the container was performed following Modification 5.

On October 6, 1997, FDF Low Level Waste Project Management was notified by Bechtel Nevada that White Metal Box Number 482793 appeared to have broken welds on both the front and back of the center runner. A grey colored material had leaked from the container. Based on the second leaking box incident (failure at the end of the center runner), FDF requested recommendations from CGR for resolution of the problem and suggested extension of the center runner flush with the side walls of the box as a possible solution to the problem. On November 20, 1997, CGR confirmed their capability to incorporate the FDF-suggested change (runners flush with side walls), but indicated the suggested change might not solve the problem and that "making the skid longer may not help or may even be detrimental."

On November 26, 1997, CGR informed the FDF Technical Representative that they had independently incorporated a center skid reinforcement (doubler plate) on container numbers 483255 through 483306. These modified containers were initially rejected by FDF pending a more detailed strength analysis of the design by CGR. On December 1, 1997, the FDF Technical Representative concluded that the containers with the installed doubler plate were acceptable.

On December 15, 1997, FDF was notified by NTS that White Metal Box number 482587 had leaked fluid and material onto the trailer bed of the truck during shipment. NTS measured the contamination levels on the trailer and the White Metal Box and found these were well below the applicable DOT and DOE release limits. NTS personnel reported the discovery of a small crack on the bottom of the leaking White Metal Box along the weld of the center runner. Later on December 15, FDF was notified of the Kingman event involving leakage and cracking in a similar place on the center runner.

On December 16, 1997, FDF was notified by NTS of four additional White Metal Boxes (numbers 482513, 482600, 482679, and 482693) discovered leaking during receipt inspection at the NTS. On December 17, 1997, FDF forwarded Modification 6, dated December 16, 1997, to CGR. Modification 6 implemented a design change to lengthen the runners to the edge of the container. For the first time the runner length was specified in the contract (on the drawing C-95-101, Rev. C).

Characterizing the Waste Stream

The FEMP is required to implement all RCRA hazardous waste characterizations in accordance with Ohio Administrative Code (OAC) 3745-52-11. This regulation requires the FEMP as a generator of solid waste to determine if the waste is hazardous as defined by RCRA. This determination is made by either (1) testing the waste in accordance with

methods defined in OAC 3745-50 through 59 and 40 CFR Parts 260-268; or (2) using process knowledge information obtained from site literature, operating procedures, manufacturer specifications or other available technical and analytical reports.

At the FEMP, the vehicle for documenting waste characterizations is through the use of a Material Evaluation Form (MEF). The MEF is used as a record of the waste characterization process and is implemented through the use of a site procedure.

Other regulatory drivers for characterizing FEMP wastes include DOE Orders, the Stipulated Amendment to the Consent Decree, the RCRA Part B Permit Application, and the Amended Consent Agreement. This process is audited by the State of Ohio Environmental Protection Agency through periodic unannounced inspections and records review. To determine whether this waste was a liquid, the 40 CFR Paint Filter Test was performed consistent with the NTS Waste Acceptance Criteria. The 49 CFR test (American Society of Testing and Materials D 4359) for liquid was not performed.

Based upon the above process, the material loaded into the two White Metal Boxes involved in the Kingman, Arizona incident, was characterized as a nonhazardous low level waste stream.

Preparation For Shipping Low-Level Radioactive Waste at the FEMP

Drums filled with waste for shipment are staged/stored outside Building 71. The drums are brought into Building 71 and set into an area where they will be opened. The drums are inspected for general condition then opened by HAZWATs. If free liquid is visible, the drums are sent to decanting for removal of excess liquid. Otherwise, they are sent to one of two packaging rooms. There the contents are emptied into a White Metal Box.

Drums are decanted in the following manner. A perforated lid is placed upon the drum, then it is inverted over a container which captures the liquid for later treatment. The time it is inverted is dependent upon the amount of liquid present and the amount of liquid that pours out. When it appears that the liquid has drained, the drum is turned upright and its lid temporarily reinstalled. Interviews indicate that it is not uncommon for a drum to be returned for additional decanting.

The drums that have been decanted and the drums that did not require decanting are staged in the packaging areas. This staging typically occurs towards the end of the shift so that drums are ready to be emptied at the beginning of the next shift. The number of drums in staging can vary from 30 to 50.

Empty White Metal Boxes are stored outside of Building 71 and brought into the building on an as needed basis. A White Metal Box is placed into the packaging area after an operational inspection for gross damage and condition. The box lid is set aside and the White Metal Box is prepared by placing a RadPad in the bottom of the box, then spreading a 50 pound bag of diatomaceous earth, trade named Dicalite, over the pad. The purpose of these two actions is to provide a sorbent for free liquids that might separate from the waste.

The lids are removed from the drums and another visual inspection is performed. If free standing liquid is observed in the drum, it is returned to the decanting area for additional decanting. Occasionally, Dicalite is added to the drum if the waste appears moist but not enough free standing liquid is present to justify additional decanting.

The drums are then emptied into White Metal Boxes. As each drum is being emptied into the container, the HAZWATs remain alert for any free liquid that may have been trapped in the drum. If free liquid is observed or the waste appears to be excessively wet, additional Dicalite is added on an as needed basis. FEMP Procedure PT-0007 calls for additional Dicalite to be added based upon the waste stream and upon Table 4 of that procedure. Once the White Metal Box is filled with waste, an additional bag of Dicalite is sometimes added across the top of the waste. As many as nine bags have sometimes been added. The decision whether to add additional Dicalite is based upon the experience of the HAZWAT. Supervisors have encouraged liberal addition of the sorbent to be more conservative than the procedure requires.

In addition to the waste, the drum liners and the Dicalite bags may also be placed into the White Metal Boxes. The drums are crushed and, depending upon operational needs, are either placed into the container or sent to another operation where they are placed into the Sea Land/transportainers, also known at Fernald as ISO containers.

When the White Metal Box is loaded, the lid is crimped into place. The boxes are removed from the packaging rooms and placed upon a rack where the boxes are inspected for cleanliness, condition, and proper markings. A radiological survey is also performed at this time. Upon successful completion of the inspections, the loaded White Metal Boxes are moved to Building 30A, where they are staged for shipment in stacks of 1, 2, or 3. The maximum of a 3 container stack is based upon material handling equipment limitations. Normally these containers are stored in Building 30A for 4 to 6 weeks before shipment. Weekly inspections of all the containers are performed while awaiting shipment. There have been no reported leaking White Metal Boxes in Building 30A.

A shipment typically consists of 7 to 9 White Metal Boxes. Prior to loading on trucks, one container per shipment is chosen randomly by the real time radiography operator to be examined by real time radiography. This is a non-intrusive process of verification that the container does not contain free liquids or other easily identifiable prohibited items. The real time radiography inspector views the process via monitor and records the inspection on video tape for a historical record. If the operator identifies free liquid, the area supervisor will be notified and the container returned to Building 71 to be opened and treated with additional sorbent. White Metal Box 4830004, which subsequently leaked, was subjected to such an inspection on November 18, 1997, prior to shipment. The radiography tape of that inspection shows no indication of free liquid.

Trailers to be loaded are brought to Building 30A and positioned at the loading dock for preparation. FEMP laborers prepare the inside of the trailer by nailing the banding plates and 2 X 4 studs into the wooden floor. This is done for the purpose of bracing the load. Once a trailer is prepared, the containers assigned to that shipment are moved out of storage in Building 30A and staged on the loading dock. Each White Metal Box is subject to a Pre-Load Inspection performed by the Waste Certification Official or his alternate, a Waste Acceptance Programs representative, in accordance with FEMP Procedure 20-C-024. This includes, among other criteria, the box being lifted by a forklift, to "head height" to facilitate visual inspection of the bottom. The container is checked to ensure that the bottom is free of adhering or entrapped soil or debris, there are no holes in the bottom, there is no free liquid on, or leaking from the bottom, and that there is no scaling, rust, or severe pitting. Other items checked during the Pre-Load inspection are such things as proper labeling, verification of radiological survey, verification of shipment number, serial number and package weight. The overall condition of the box is also checked. However, it has been determined through interviews that there is limited visibility of the

side of the White Metal Box nearest the forklift.

The White Metal Boxes are loaded into the trailer by a qualified Motor Vehicle Operator (MVO) with visual guidance by a loading team member. The first container is placed against the bracing and each subsequent container is placed as close as possible against the previous one. MVOs and supervisors state that it is a common practice to "bump" the boxes together. In doing this, an effort is made to keep the forks in a tilted forward position to prevent coming in contact with the previously positioned box. This is important because the forks extend 1 to 2 inches beyond the far side of the box. The White Metal Boxes are banded together in bundles of 3 or 4, depending upon the total number to be loaded and the position of the bundle. A radiation control technician takes a verification smear of each box as it is being loaded. Two photographs are taken of the trailer contents. One photograph after the first bundle is secured and another when the rear bundle is secured.

The waste programs representative performs a trailer inspection in accordance with FEMP Procedure 20-C-024. This procedure includes another visual inspection of all surfaces of the container to verify the absence of damage to the box and leaks. Tie-downs are inspected to verify accordance with Procedure 50-C-109. The waste programs representative also verifies that all radiological surveys and trailer inspections have been properly completed. The trailer doors are closed and secured with a DOT-approved seal. The truck driver is briefed, all appropriate paperwork is transferred to him, and the shipment departs for the NTS.

Upon arrival at the NTS, the paperwork, markings, and placarding are checked, and radiological surveys are performed before the trailer is opened. After opening the trailer, a radiological and visual survey of the load and the inside of the trailer is accomplished. Additionally, a visual and radiological survey of each container is performed. To inspect the underside of the box, it is raised by a forktruck so the inspector can visually examine that portion of the box. No waste verification sampling is performed on wastes arriving at NTS for disposal.

Procedures have not been changed greatly in the last 5 years. HAZWATs and Waste Technicians participate in procedure revisions as subject matter experts. Interviews demonstrated that HAZWATs, Waste Technicians, and supervisors were generally knowledgeable of and worked in accordance with the appropriate procedures. The procedures were readily available in all work areas. HAZWAT training requires that they read and sign off on each procedure applicable to the area in which they work. Waste Technicians have no similar formal requirement, but one is currently under development.

Most HAZWATs, Waste Technicians, and Motor Vehicle Operators interviewed have been in their positions for at least 3 years. Team composition is consistent. Interviews indicated that some personnel have concerns with the frequent reorganization of the FDF Waste Management organization. There have been at least three FDF Waste Management reorganizations since 1995.

2.2.3 Related Factors - Precursor Events

There have been previous White Metal Box failures and other indicators of both unexpected levels of free liquid in the loaded containers and incipient structural weaknesses. These include the following:

January 3, 1995

ORPS # OH-FN-FERM-FEMP-1995-0008 reported a January 3, 1995, failure of White Metal Box Number 653774 on January19, 1995. This box was not produced under the CGR contract. The container was leaking liquid from weld holes in the bottom of the box while in transit. Also included in this ORPS report was a December 30, 1994, incident in which another White Metal Box, 653739, was removed from a trailer while still at the FEMP because it had a similar leak. These events were categorized as off normal because the containers did not meet the DOT standard, i.e. a "strong tight packages so that there will be no leakage." The description of cause states in part "...there is a lack of performance testing for containers ... by FEMP to conform to vendor data...". A failure rate of 10% was experienced in this lot of containers.

May 21,1997
This event involved a White Metal Box manufactured by CGR. Number 482403 was loaded on May 2, 1997, with 20 ten gallon cans of depleted uranium tetrafluoride, six 55 gallon drums of filter cake; one sorbent pad; and 50 pounds (one bag) of Dicalite as a sorbent. The box was inspected and loaded onto a trailer on May 12, 1997, with no nonconformances noted. The shipment departed FEMP on May 16, 1997. Upon opening the trailer, NTS personnel noted that liquid had leaked on the trailer floor and the floor of the trailer was contaminated. The event was classified as a nonconformance by Bechtel Nevada and a nonconformance report was issued by FDF.

October 5,1997

One White Metal Box was found to be leaking while unloading at the NTS. There was no requirement for NTS to write a nonconformance (shipment was not regulated), however, Bechtel Nevada notified FDF. The FDF Assistant Emergency Duty Officer was notified and entered the notification on his log as a "Loggable Event." A nonconformance was not written by FDF.

2.2.4 Management Systems

2.2.4.1 FDF Quality Assurance and Corrective Action Tracking

The FDF Waste Certification function was transferred from Quality Assurance to Low Level Waste operations during a reorganization in January 1997. This reorganization left only one FDF Quality Assurance person to perform Quality Assurance duties related to waste certification where previously four had been assigned.

FDF has three corrective action tracking systems used to track and manage closure of any open nonconformance or action. Any Corrective Action Requests provided by DOE Nevada Operations Office to DOE-FEMP are transmitted to FDF where specific corrective actions are formulated, assigned to appropriate personnel for action, and entered for tracking and closure.

2.2.4.2 DOE Oversight

DOE-FEMP tracks and verifies closure of all concerns identified during DOE assessment activities. Also, DOE-FEMP has a centralized action tracking system which tracks the correspondence (and the status of any actions that may arise) related to corrective actions that originate with incoming correspondence, such as a Nevada Corrective Action Request.

A primary means of operational oversight for the DOE-FEMP Office is the Facility Representative program. DOE Facility Representatives are assigned responsibility for one or more facilities and are to perform walk throughs at least weekly. The Board interviewed the previous Facility Representative and the current Facility Representative for Buildings 30A and 71. The previous Facility Representative had responsibility for those buildings from April 1995 until July 1997. The current DOE Facility Representative for Buildings 30A and 71 has had that responsibility since July 1997. Both stated that no major discrepancies had been discovered. The DOE Waste Management team leader stated that he strives to conduct walk-throughs of all waste management areas weekly and requests the same of his team members but, due to conflicting duties, this has not always been done.

2.2.4.3 Corrective Action System Response to Precursor Events

Response to January 3, 1995 Precursor

Defective White Metal Box welds were identified in loaded containers at the FEMP on December 30, 1994 and at NTS on January 3, 1995. FDF developed corrective actions to address the root cause of "inadequate supervision" identified in the ORPS report (ORO-FERM-FEMP-1995-0008) for this event. FDF committed to completing the following corrective actions:

1) Evaluate and revise waste packaging procedures to assure appropriate amounts of absorbent material are added to current and future shipments. The box loading procedure was amended to add 50 lbs of Dicalite on the bottom of every box before it was loaded.

2) Increase management oversight of waste packaging operations by conducting frequent self-assessments with technical support personnel Surveillances were increased to quarterly but the self-assessment frequency remained the same. FDF considered the surveillances to be self-assessments.

3) Perform surveillance of waste packaging operations on, at least, a quarterly basis Surveillances were increased to quarterly but the self-assessment frequency remained the same. FDF considered the surveillances to be self-assessments.

4) Perform detailed visual inspections of support welds on White Metal Boxes loaded for shipment Weld inspection frequency was increased to 10%.

5) Revise future contract specifications for White Metal Boxes to include weld examination and random testing of 10% of the containers. The Request for Proposal for the new White Metal Box that was issued in April 1995 included a requirement to perform a 5% visual weld inspection and perform annual testing of the containers.

Response to May 21, 1997 Precursor

On May 21, 1997, NTS identified a leaking White Metal Box on a shipment received from FEMP. This was reported to the FDF Low Level Waste Project Manager by telephone and confirmed in a formal Corrective Action Request dated July 7, 1997. FDF issued a nonconformance report on May 27, 1997, (NCR 97-0138) documenting certain planned corrective actions to prevent a recurrence of the problem. DOE-FEMP transmitted FDF closure of the NTS Corrective Action Request on August 12, 1997, and FDF confirmed closing of NCR 97-0138 by electronic mail on August 15, 1997. NTS conducted a field

surveillance at FEMP on August 19 - 20, 1997 and subsequently closed the Corrective Action Request in a letter dated September 19, 1997. Based on the information received to date, the Board could not verify closure of all the corrective actions committed to by FDF in NCR 97-0138.

1) Revise procedure, PT-0007, Packaging Low Level Radioactive Waste (LLRW) in Metal Boxes for Shipment to the Nevada Test Site, to incorporate provisions for adding adequate amounts of absorbent Procedure PT-0007 was revised by adding a table to identify the amount of sorbent based on waste type.

2) Increase waste certification to weekly surveillances to ensure procedural compliance The surveillances by Waste Certification were increased to weekly; however, during the 16 weeks preceding the December 15, 1997, event only 10 surveillances had been performed.

3) Evaluate absorbent material calculations and assumptions by July 15, 1997 Evidence presented to the Board shows that the original 1995 data was used to create the new table that was added to PT-0007, which restated that Dicalite will sorb at a rate of 2 gallons per pound.

4) Conduct an evaluation of available products of absorbents and methods of application for waste stream materials and implement if technically feasible and cost effective Following this event, procedures were modified to ensure there was a 100% pre-load and post-load inspection of boxes. Evidence provided to the Board indicated that alternate sorbents were not seriously evaluated and never made available for use.

DOE concurred that these actions were complete.

Response to October 5,1997 Precursor

The Board was unable to identify a formal documented corrective action to the October 5,1997 White Metal Box leak reported by NTS.

2.2.4.4 Management Communication, Direction, and Control

White Metal Box Procurement and Acceptance Process

The CGR test sample provided during proposal evaluation testing did not match the design of the White Metal Boxes that were delivered under the resulting contract, beginning in September 1995. In particular, the sample photographed and videotaped during the June 1995 testing had a center runner that extended somewhat beyond the sides of the container. Those delivered under the contract, until the most recent contract modifications, had a center runner that was recessed under the container. The contract resulting from the June 1995 testing did not include specifications that would ensure that the design delivered would reflect the design tested (such as detailed drawings and specifications for the successful design). The difference between the tested container and the later containers delivered under the contract was not detected by FDF upon contract delivery. The contract data package does not include sufficiently detailed drawings to allow such an inspection. It was also noted by the Board that the FDF Quality Assurance inspector who witnessed the performance testing was not the inspector who conducted the acceptance inspection for the initial shipment of White Metal Boxes. The Board also

noted that, while the contract data package did not explicitly include detailed drawings, the initial internal CGR quality control documentation clearly shows that the center and two end runners for the White Metal Box could be recessed as much as seven-sixteenths of an inch from the sides of the box.

As the FDF contract with CGR continued, there was a significant level of turnover in FDF's technical representatives. There have been four separate technical representatives assigned to this contract by FDF in the approximately 2½ years since the contract was awarded to CGR in August 1995. During that time, six modifications to the container design have been approved with little design review or testing of the resulting design. However, in November 1997, the latest FDF technical representative identified problems with the White Metal Box design and the rate of failure experienced in this box along the center runner at the base. As a result of this action, a modification to the White Metal Box design was subsequently approved in December 1997. On December 16, 1997, DOE-OH/FEMP directed that no further shipments of these boxes from FEMP to NTS would occur. On December 29, 1997, the Assistant Secretary for Environmental Management directed that all shipments of low level waste to NTS from the DOE complex using this White Metal Box would be suspended until the Type B investigation into this issue was completed. In the meantime, FDF continued to fill these containers at FEMP with the understanding that these boxes may require repackaging in the future.

Low Level Waste Operations

Interviews revealed that there was a substantial level of involvement by operators and supervisors in operations at Buildings 30A and 71. The procedures used in these operations were updated with input from the operators and the operators were well aware of the content of these procedures. All operators believed they had the authority to reject any drum based upon free standing water. In addition, supervisors expressed strong confidence in the ability of operators to make these determinations. The processes established by the procedures were followed by operators, waste technicians, waste certification operators, and transportation managers.

On at least one occasion, an operator suggested to management that the current sorbent, Dicalite, did not appear to be effective. Management responded that additional information was needed to make any determination. In addition, management had received as late as July 1997 confirmation that Dicalite was an effective sorbent based upon a jar test of its effectiveness; the basis for this assessment was performance testing that was conducted in January 1995. The results of this test do not agree with the manufacturer's specifications.

On December 23, 1997, a Corrective Action Request (RWAP-C-98-09) was provided by the DOE Nevada Operations Office to DOE-FEMP. This corrective action request included the statement that "Fernald personnel stated that the weekly surveillances were not being conducted and that only two surveillances had been conducted." This information was derived from conversations between contractor employees at Nevada and FEMP, respectively, and was incorrect. In fact, ten of a possible sixteen surveillances were conducted from June 14, 1997 through December 19, 1997 (1 in June, 2 in July, 4 in August, 1 in October, and 2 in December). Interviews indicated that this example of one-on-one, informal communication accompanied by little formal documentation is common.

Some DOE-FEMP personnel who are engaged in DOE oversight of FDF indicated in

interviews that oversight of FDF procurements was precluded by the Business Management Oversight Program. Managers interviewed at DOE Ohio Field Office stated that this is not the case and that DOE-FEMP is allowed to perform oversight of design, source inspection, and procurement of White Metal Boxes.

2.3 BARRIER ANALYSIS

A barrier is defined as anything that is used to control, prevent, or impede the processes that may lead to an incident or an injury. The barrier analysis conducted by the Board addressed three types of barriers associated with the event: administrative barriers, management barriers, and physical barriers. Only the final physical barrier, the integrity of the White Metal Box, would have assured the prevention of leakage from the box; however, effective performance by any of several other barriers might have interrupted the chain of events that led to a leakage of material outside the transportation vehicle. The more significant barriers are summarized in Figure 2.9

2.3.1 Administrative Barriers

Analyses of the hazards associated with the transportation of low level waste to the NTS were performed. These analyses included consideration of the radiation hazards and the other hazards associated with the material. As a result, a number of controls were identified to ensure that safety and environmental standards were met. These procedures were generally effective. However, the low level of risk to the public and the environment associated with these shipments caused management attention and concern to shift to other operations with potentially greater health and safety risks. The programmatic risk of a leak of material, harmful or not, along the transportation route was not included in the risk analysis. The inclusion of programmatic risks could have focused a more appropriate level of management attention on this program, resulting in a higher level of oversight and upper management involvement. Since programmatic risks were not included, this barrier was ineffective in identifying areas requiring emphasis and therefore this barrier was only partially effective.

Extensive planning was carried out and this planning was evident in the completeness of procedures and quality assurance steps that were identified in the loading, shipping, and receiving of low level radioactive waste at FEMP and NTS. However, the effectiveness of these plans and procedures was significantly reduced by incomplete information in three

key areas: 1) the sorptive characteristics of Dicalite; 2) the behavior of the moisture trapped in the waste stream under the conditions encountered in storage and shipment; and 3) the strength of the White Metal Box. Due to a lack of sufficient understanding of these areas, the existing procedures were ineffective in preventing the event.

The Board found the training, experience, and knowledge of the workers and line supervisors to be consistent with the needs of their positions. In this instance, all concerned performed their tasks adequately. In fact, the Board noted that the HAZWATs questioned the efficacy of Dicalite based on direct observation (discussed more fully in Section 2.2). Even in those areas where technical misjudgements were made (e.g., Dicalite, behavior of the waste streams during transportation, and White Metal Box design weaknesses), the causes of the misjudgements were subtle enough to be easily overlooked by qualified personnel in the absence of performance indicators such as failed containers.

The procurement process was expected to provide a strong, tight container. It did not through a series of misjudgements. FDF developed a Request For Proposal based on meeting tests specified by Chapter 49, Code Of Federal Regulations for Department of Transportation-approved shipping containers. The proposed design was subjected to the specified tests and passed them all. However, the resulting contract was not sufficiently detailed to ensure that the containers delivered under the contract were identical to the containers tested. One of the design differences between the tested design and the design of the containers delivered formed a weak point at which this failure and others occurred. Therefore, this barrier was ineffective.

2.3.2 Management Barriers

Effective communication both up and down the management chain is key to identifying and mitigating hazards. In several instances communications weaknesses were observed. Information flow between DOE-FEMP and FDF, between DOE-FEMP and DOE Nevada, and within FDF was often informal. While extensive informal communication is expected and, indeed, critical at each technical and managerial level, a level of formality sufficient to ensure the elevation of significant problems and concerns should exist. Perhaps due to the perceived low level of risk associated with these shipments, there was no trending or analysis of the precursor events to identify the necessity of action to management. Expectations for oversight under the emerging Business Management Oversight Program were not clearly understood by all, thereby reducing to some degree the level of oversight applied. Tolerance for leaking containers was informally transmitted by the lack of urgency given to leaking containers relative to other container-related issues. In particular, the different level of concern felt regarding a leak that escaped a transportation vehicle en route relative to a leak discovered when the vehicle was unpacked was not adequately conveyed. Partially as a result of such communications failures, opportunities to properly analyze and evaluate precursor events may have been lost.

A structured and integrated management system featuring clearly defined roles, responsibilities and authorities assures that issues requiring resolution are identified, that adequate resources are devoted to their resolution, and that all areas of the organization are effective in supporting the mission of the organization. The FDF and DOE-FEMP management systems were not fully effective. Roles and authorities were not clearly established between DOE-FEMP and DOE Nevada with regard to validation and closure of corrective actions taken to address identified programmatic shortcomings. When a leaking container was observed during unloading at NTS in May 1997, DOE Nevada requested that

DOE-FEMP conduct corrective actions. DOE-FEMP passed the action to FDF and forwarded the FDF letter stating that corrective actions had been completed to DOE Nevada without specific evidence that actions had been performed. In addition, DOE-FEMP has not specifically confirmed that the corrective actions have continued to be performed. DOE Nevada conducted a surveillance to confirm closure of these issues, but limited its rigor to spot checking. The lack of a formal agreement as to roles and responsibilities for validation, closure, and follow up of corrective actions, in particular who was responsible for detailed follow up of corrective action commitments, weakened this barrier and possibly prevented the detection of additional indicators of false technical assumptions and other weaknesses in the FDF program.

DOE-FEMP and FDF oversight was hampered by a multiplicity of systems for tracking corrective actions. For example, issues identified by DOE-FEMP assessments were placed into a tracking data base while corrective action requests originating with DOE Nevada were tracked only as suspense items in a correspondence and action tracking system that did not include any detail on the corrective action taken. No procedure precluded the entry of the Nevada concerns in the tracking data base, but it has been left to the discretion of the recipient of the correspondence to enter data. Similarly, FDF has multiple systems into which various corrective actions may be placed. These multiple tracking systems without a central focus are detrimental to development of a trending and analysis function that might have integrated the several precursor events into a composite indicating that from time to time a leaking container is loaded with waste with a higher than expected amount of free liquid.

2.3.3 Physical Barriers

The first physical barrier was the complex of procedures and quality checks that was designed to preclude free liquids from shipments. There is evidence that this system had failed on other occasions. The Board concluded that in this case a combination of shaking incident to transportation and the ineffectiveness of Dicalite as a sorbent material caused free liquid to separate from the waste in White Metal Boxes 483004 and 483141 during shipment, defeating this barrier.

The final physical barrier was the White Metal Box. The container was believed to be a strong tight container tested to Department of Transportation specifications that were more stringent than required for the waste carried. This belief was false. The analyses performed for the Board by Sandia National Laboratories/New Mexico argue strongly that the failure they analyzed occurred before shipment and then widened during transportation, culminating in the leak detected in Kingman, Arizona. The other failure in 483141 has been submitted for analysis by CGR, but results are not yet available. The Board concludes that the integrity of each White Metal Box was breeched during transportation, causing this barrier to fail.

2.4 CHANGE ANALYSIS

A change analysis was conducted to determine changes or differences that may have contributed to the event. The results of the analysis are provided in Table 2.1.

Table 2.1 Change Analysis

Prior or Ideal Condition	Observed Condition	Difference (Change)	Analysis
The White Metal Boxes have requirements in the procurement contract for performance testing to ensure the integrity of the container.	The White Metal Boxes delivered by the contractor differed from the original design prototype tested.	The White Metal Box design delivered did not match the one tested. In fact, numerous modifications to the basic design have been made since contract inception. The full suite of tests required by the contract were not conducted on the modified designs.	White Metal Box Testing as performed on the modified designs did not ensure physical integrity of the White Metal Boxes received.
Procedure PT-0007, "Packaging Low-Level Radioactive Waste in Metal Boxes for Shipment" requires 1) no free liquid and 2) the addition of sorbent material in the waste.	Free liquid is present in some White Metal Box containers during and after transportation.	Material is packed with no free liquid present and with sorbent material, yet free liquid is observed.	1) Waste Stream physical characteristics are unclear in regards to free liquid and 2) Sorbent material does not ensure the absence of free liquid.
White Metal Box is a strong, tight container.	White Metal Box integrity failures of May and October 1997 were discovered at NTS.	White Metal Boxes have failed and leaked material in earlier events.	Significance of the failed White Metal Boxes was not recognized earlier and the root cause analysis did not identify a means for preventing recurrence.
A formal corrective action program allows site operations to effectively evaluate and track corrective actions and is a tool for communications between staff and management.	There is not a formal process for resolving issues involving both NTS and FEMP organizations.	The May and Oct. incidents resulted in routine, informal communications, root cause analysis, corrective actions and follow up.	A formal corrective action program may have identified integrity issues earlier to management and may have identified the earlier, inadequate corrective actions.

Prior or Ideal Condition	Observed Condition	Difference (Change)	Analysis
There is a formal plan that specifies the mission, scope of operations, logistic procedures, equipment and personnel requirements and authorities of the FEMP Support Team to consistently and effectively respond to transportation events.	Although effective for this event, no formal plan exists for deploying a FEMP Support Team to a distant incident scene.	Although for this event the FEMP Support Team was effective and their efforts greatly supported recovery actions, there is some question whether this level of effectiveness could be maintained in future events without preplanning documents.	The missions for the support team changed: the Support Team started as a consultant team, but later became a response team that assumed on-scene control of the recovery operation. Although the FEMP Support Team accomplished these recovery missions well, additional formal planning would ensure that the personnel dispatched could perform this effort consistently.

2.5 CAUSAL FACTORS

The **direct cause** of the event (the immediate events or conditions that caused the incident) was the loss of integrity of two White Metal Boxes containing unexpected quantities of free liquid. The root cause (the fundamental cause that, if eliminated or modified, would prevent recurrence of this and similar accidents) was **the failure of the FDF contracting process to deliver a strong tight container as required by contract specifications.**

This root cause, if changed, would have prevented the incident and other similar incidents involving FEMP White Metal Box shipments. However, it is important to emphasize the ways in which the contracting process failed. First, contracting process did not capture design data from the container that passed the performance tests. Second, the process did not specify the successful design in the resulting contract. Third, the annual testing that might have revealed the impact of the changed design were waived. Finally, a number of modifications have been made to the original design procured. Subsequent configuration control and testing, when it was not waived, had not sufficiently assured that the White Metal Boxes on hand at FEMP would pass the required performance tests.

The Board also identified several contributing causes (causes that increased the likelihood of the event without individually causing the event, but that are important enough to be recognized as needing corrective action). All causal factors are identified in Table 2-2 with

a short discussion describing the importance of each. Exhibit F presents a summary events and causal factors chart.

Table 2-2 Causal Factors

Causal Factor	Discussion
Root Cause	
The FDF contracting process did not deliver a strong tight container as required by contract specifications.	All risk analysis and planning for the shipment of low level radioactive waste was predicated on the White Metal Box meeting the "strong, tight box" requirement. Failure of the box can cause leaks, whether the waste contains liquid or not, although the likelihood of leaks from the trailer is increased by the presence of free liquid.
Contributing Causes	
DOE-FEMP and FDF continued to use the White Metal Boxes for shipment of low level waste following the precursor leaking White Metal Boxes in May and October, 1997. White Metal Box operations were not discontinued in November 1997 after FDF determined the box design was inadequate.	If the risk of shipping with a flawed White Metal Box had been properly evaluated following any of these indicators, it is possible that the Kingman event would not have occurred.
FDF and DOE-FEMP do not fully understand the physical characteristics of the waste form. The mixture of the waste and the sorbent material (Dicalite) in the White Metal Boxes did not prevent the separation of free liquid during shipment.	While the absence of free liquid might not have prevented a leak, it is likely that the leak would have been confined to the transport trailer. Further, understanding the origin and behavior of the free liquid on the shipped waste may be an important issue for the Nevada disposal site.
The division of roles and responsibilities between DOE Fernald and DOE Nevada for identifying and ensuring the integrity of waste shipments is not clearly defined.	The lack of specificity in the informal understandings of roles and responsibilities led to a false confidence that corrective actions had been effectively implemented by the contractor.
Senior management at FDF/DOE Fernald/DOE OH did not recognize the potential programmatic and operational impact as it related to the graded approach for oversight.	The program was viewed as a low risk program because of its low impact on health and safety. The importance of a potential leak during transport was not considered or was given a lesser weight than was justified in light of subsequent events.

3.0 CONCLUSIONS AND JUDGEMENTS OF NEED

Conclusions are a synopsis of those facts and analytical results that the Board considers especially significant. Judgements of need are managerial controls and safety measures believed necessary to prevent or mitigate the probability or severity of a recurrence. They flow from the conclusions and causal factors and are directed at guiding managers in developing follow up actions. Table 3-1 summarizes conclusions of the Board and judgements of need.

Table 3-1. Conclusions and Judgements of Need

Conclusions	Judgements of Need
All the White Metal Box designs on hand have the same design features as the failed boxes and/or have not been adequately tested to determine whether they might experience the same failure.	FDF needs to ensure all White Metal Box designs meet performance criteria and receive DOE approval prior to shipping.
None of the White Metal Boxes delivered and accepted were of the same design as the metal box supplied by CGR for testing prior to contract award, nor was configuration control of subsequent design changes sufficiently rigorous to ensure that delivered containers met all requirements and operational criteria, such as stacking.	FDF needs to improve the procurement process to ensure program operational requirements are met. Special emphasis should be placed on interface with technical/support functions.
Dicalite is not a sufficiently effective sorbent to be used as described in procedure PT-0007.	FDF needs to understand the physical properties of the high moisture content waste streams and the effects of sorbents in packaging and transportation.
Although the FEMP Support Team efforts during recovery actions were effective, planning and preparation for the dispatch of the FEMP Support Team was insufficient to ensure consistent performance if deployed in response to future incidents.	FDF needs to develop more comprehensive formal plans for deploying Support Teams at significant distances from FEMP. In addition to identifying a clear mission statement, special emphasis should be placed on travel arrangements, suitable equipment sets, training and certification for team members, and possible assumptions of liability following certain Team actions.

Conclusions	Judgements of Need
DOE-FEMP did not adequately review the FDF procurement of the White Metal Box, did not assure effective validation of contractor corrective action closure, used multiple systems to track the status of concerns, and did not have a program to identify programmatic trends based on all information available.	DOE-FEMP and DOE Ohio need to improve their contractor oversight, and FDF needs to improve their self assessment and quality assurance programs. Areas for improvement include conducting formal program audits, developing a programmatic trending and tracking capability with access to all applicable status information, and continuing to monitor ongoing corrective action commitments.
DOE roles and responsibilities regarding the interface between DOE-FEMP and DOE Nevada are not clearly defined in the areas of notification and follow up to FEMP issues identified by NTS when shipments are unloaded.	DOE-FEMP, DOE Ohio and DOE Nevada need to clarify the roles and responsibilities for notification, validation and closeout of corrective actions, including root cause analysis.
The sensitivity of a leaking low level radioactive waste shipment was not properly factored into the risk analysis for these shipments to NTS even though the health and safety of the public and the environment were not harmed, since the released liquid was non-hazardous and not harmful to the environment.	The Office of the Assistant Secretary for Environmental Management, in conjunction with DOE Ohio, DOE Nevada, and other affected parties, needs to establish criteria for transportation of low level waste so that programmatic and operational needs can be properly assessed.

4.0 BOARD SIGNATURES

David R. Kozlowski, Board Chairperson Date
U.S. Department of Energy
Fernald Environmental Management Project

Robert F. Danner, Board Member Date
U.S. Department of Energy
Fernald Environmental Management Project

Gregory J. Duggan, Board Member Date
U.S. Department of Energy
Idaho Operations Office

Joseph M. Ginanni, Board Member Date
U.S. Department of Energy
Nevada Operations Office

Brian R. Hermann, Board Member Date
U.S. Department of Energy
Albuquerque Operations Office

Donald L. Lee, Board Member Date
U.S. Department of Energy
Ohio Field Office

Timothy J. Marcus, Board Member Date
Trained Accident Investigator
U.S. Department of Energy
Ohio Field Office

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5.0 PARTICIPANTS

Board Members, Advisors, Consultants, and Staff

Chairperson	David R. Kozlowski, DOE-Fernald
Member	Robert F. Danner, DOE-Fernald
Member	Gregory J. Duggan, DOE-Idaho
Member	Joseph M. Ginanni, DOE-Nevada
Member	Brian R. Hermann, DOE-Albuquerque
Member	Donald L. Lee, DOE-Ohio
Member	Timothy J. Marcus, DOE-Ohio
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Technical Advisor	Randy Gist, DOE-Fernald
Technical Advisor	Nancy Mazzuckelli, DOE-Fernald
Technical Advisor	Joseph Neyer, DOE-Fernald
Technical Advisor	Dennis Riley, DOE-FEMP
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Advisor/Management Analyst	Richard Donovan, Eagle Research Group
Analyst	Michael Lloyd, Battelle
Analyst	Gary Swearingen, Battelle
Administrative Support	Cynthia Holland, DOE-Fernald
Consultant	Loretta Parsons, DOE-Fernald
Consultant	Donald Pfister, PE, DOE-Fernald

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APPENDICES

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APPENDIX A
Letter of Appointment

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APPENDIX B
Chronology

Chronology of Precursor Events, Events Related to the Accident, Response, and Recovery (All times are Eastern Standard Time)

01/19/95	Leaking box incident (old White Metal Box (WMB) manufacturer). ORPS #OH-FN-FERM-FEMP-1995-0008
04/10/95	Fluor Daniel Fernald (FDF) issues the White Metal Box Request For Proposal (RFP) to 16 businesses. FDF Buyer #1 assigned.
04/21/95	Seven potential vendors attend pre-award meeting.
05/05/95	Nine proposals received.
06/13/95	CGR Compacting, Inc. (CGR) has highest score on evaluation of proposals.
06/15/95	CGR passes pre-award survey.
07/06/95	CGR design box passes performance tests.
08/30/95	CGR awarded WMB contract with Contract Technical Representative (CTR) #1
10/02/95	CGR shipped first release (box # 420000).
10/11/95	Contract Modification 1 issued to change weld spec to allow internal weep hole in the support rail and new CTR (#2).
11/17/95	Waste Programs approved waiver for source inspections based on CGR performance.
02/20/96	Contract Modification 2 changed the paint spec to reflect use of paint manufacturer's recommended application.
06/19/96	Purchase order (PO) issued for boxes 421641 - 421848.
07/16/96	FDF requested lighter lid; CGR suggested elimination of annual testing based on new CFR, elimination of redundant welding and painting changes. FDF requested written proposal.
08/29/96	Contract Modification 3 exercises option year 1, associated price reduction for elimination of finish painting on interior of boxes with new CTR (#3)
09/30/96	Numbering sequence for WMB skips to 481000 series.
03/05/97	New design boxes (all 12 GA metal) tested and witnessed by FDF; some tests waived by FDF.
03/14/97	PO issued for 12 GA boxes

03/15/97	FDF procurement assigns new buyer (#2) for contract.
03/20/97	CGR issues Quality Assurance (QA) checklist indicating that 3/16" fillet weld would be placed at the ends of each WMB runner.
03/31/97	Contract Modification 4 issued (s.n.#482267) all 12 GA metal, reduced welding, reduced cost.
04/03/97	FDF Low Level Waste Project (LLW) engineer authorized moving serial number plate without contract mod.
05/02/97	WMB 482403 packaged.
05/10/97	CGR informs FDF of intent to use more foreign steel.
05/16/97	FDF ships box 482384 (first all 12 GA construction).
05/21/97	Nevada Test Site (NTS) finds Box 482384 leaked.
05/21/97	NTS notifies FDF (by telephone) of leak on box 482384 and FDF logs event.
05/22/97	WMB over pressurizes at FEMP.
05/27/97	FDF Nonconformance 97-0138 issued to address 05/20/97 leak identified by NTS.
06/03/97	FDF Waste Certification performed source inspection against drawing not in contract.
	DOE-NV notified by Bechtel Nevada of a Notice of Discrepancy on the 05/20/97 leaking WMB.
06/04/97	Waste Certification Officer (WCO) increases certification oversight schedule to weekly surveillances as a result of the 05/20/97 leaker.
06/13/97	LLW engineer notes distortion of 12 GA base due to tack welding of runners.
06/23/97	LLW engineer requests return to 11 GA bases.
06/27/97	CGR verbally instructed by FDF buyer to use 11 GA bases at increased price.
	NTS initiates Corrective Action Request (CAR) 9701/02 for 05/20/97 leaking box incident.
07/07/97	DOE RWAP Program Manager signs CAR 9701/02.
07/18/97	FDF QA determines use of 12 GA steel did not violate specification.
08/07/97	PT-007 revised amount of absorbent added as a result of the 05/20/97 leaker.
08/08/97	CGR starts manufacture of 11 GA base box 843020. Delay was to negotiate price.
08/19/97-08/20/97	NTS surveillance of FDF Waste Program.

09/19/97 NTS closed CAR from May events.

09/27/97 Contract Modification 5 issued to reflect use of 11 GA bases with price increase.

10/05/97 NTS finds leak in Box 482793.

10/06/97 NTS notifies FDF of leak from box 482793.

11/09/97 FDF appoints CTR #4.

11/12/97 LLW suggests extending runner to edge of box.

11/20/97 CGR agrees to extend runner to edge of box starting with 843307.

11/25/97 CTR #4 assumes duties.

11/26/97 CGR informs FDF that they had incorporated a center plate doubler in boxes 483255 to 483306.

FDF issues hold on boxes 483255 - 483306.

12/01/97 FDF accepts doubler plate design.

12/03/97 FDF issues CAR 97-0436 on doubler plate design.

12/08/97 FDF resumes shipping of "06" residues.

12/12/97 FDF loads truck with WMBs 483004 and 483141.

12/15/97 Monday

1425 FDF notified of leaking box at NTS and logs event.
1654 FDF notified of leaking box in Kingman, AZ.
1705 FDF Emergency Duty Officer (EDO) classifies event as Transportation Operational Emergency (transportation accident involving a shipment of hazardous or radiological material originating from FEMP in which the integrity of the shipment is in doubt or cannot readily determined) and directs FDF Communications Center to initiate Emergency Operations Center (EOC) activation.

1709 Tri-State Motor Carrier notified EPA National Response Center and Arizona Radiological Regulatory Agency.
1715 FDF AEDO notifies DOE-HQ EOC of Transportation Operational Emergency.
1720 Assistant Fire Chief Kingman Fire Department received telephone call from Mojave County Sheriff Deputy. Notified of a HAZMAT incident involving Radiological material, that the driver was available at scene and that it was low level waste. Dispatched/proceeded to scene. Incident Scene was outside the normal Kingman Fire Department's jurisdiction. Sheriff Deputy had established an exclusion zone of approx 350 feet. While en route, Kingman Fire Department notified AZ Department of Public Safety (DPS) Transportation Specialist. Kingman Fire Department was advised by DPS that AZ Radiological Regulatory Agency had been notified and was en route to Kingman AZ.
1741 Kingman Fire Department arrived at Scene, I-40 West bound on Exit 66 exit ramp.

	Met Sheriff Deputy on scene. During initial discussion with the sheriff deputy, Kingman Fire Department reviewed shipping papers. Truck driver notified Kingman Fire Department (KFD) Asst. Chief that the FEMP EOC was on the phone at the Petro Fuel Station about 600 feet away.
~1750	KFD established phone contact with FEMP Emergency Operations Center. FEMP EOC Field Communicator advised the on scene command: 1) Not to open rear doors of trailer; 2) that a team from DOE was being deployed; 3) load was "extremely low level waste;" and 4) that container should not be leaking.
1751	FEMP EOC declared operational.
~1755	Asst KFD Chief assumes Incident Command for incident scene as a HAZMAT Incident (Sheriff Deputy concurs). KFD assures exclusion zone established.
1804	FEMP EOC DOE liaison contacts DOE-HQ and requests RAP Team assistance.
1813	DOE-AL EOC forwarded a call from DP-23 to the Deputy RAP Manager.
1823	FEMP EOC calls the AL EOC EMB Branch Chief with information on the incident. EMB Branch Chief calls Deputy Manager of the AL RAP Team to discuss plans and resources available.
1827	Deputy Manager of RAP Team notifies State of Arizona Radiation Regulatory Agency of the incident and was advised that the State On Scene Coordinator was AZ DPS Officer, who was en route to the scene.
1834	Kingman AZ Hazmat Support Unit Dispatched to scene by the KFD Asst Chief.
1835	AZ Department of Public Safety officer arrives on scene.
1845	FEMP Support Team designated and directed to deploy to event scene. Support Team briefed for technical support role and provided with response kit.
1850	KFD Hazmat Support Unit arrives at scene and is briefed by KFD Asst Chief. Assigned task of performing radiological monitoring of perimeter and performing visual inspection for release rate and I.D. of fluid leaking.
1855	FDF EOC confirms notifications made to Secretary of Energy, Office of EM-1, DOE-OH Deputy Manager and EDO, OEPA (Courtesy Call), Local Stakeholder.
1900	KFD Entry Team enters exclusion zone. KFD Hazmat Team equipment consists of CDV 700 and CDV 138 dosimeter. No readings above background observed. Team estimates 2/3 gallons of clear fluid leaked from trailer.
1903	Secretary Pena's Senior Environmental Advisor called for information on the deployment of the AL (Region 4) vs NV (Region 8) RAP Team.
1915	Deputy manager of RAP Team conference calls with DOE-AL and DOE-NV RAP Team managers discuss response times. DOE-NV response time greater than AL team. AL RAP team to deploy.
1920	KFD Entry Team exits exclusion zone. Assumes a monitoring and observation posture at event scene to wait for AL RAP Team.
1925	AL EOC contacts DOE-HQ to provides update on RAP Team dispatch.
1930	FEMP EOC initiates recovery planning.
1955	FEMP Response Team member receives response kits and proceeds to airport for 2050 flight to Las Vegas, Nevada.
~2100	FDF Operations Advisor in the FEMP EOC called NTS Ops Manager to determine which trucks were at Nevada Test Site and which were still in transit. The NTS Ops Manager was not aware of the Kingman incident and provided the information on the trucks. The FEMP EOC did not contact the DOE NV EOC.
2106	AL EOC faxes situation reports to DP-23, DOE-HQ EOC and AL management.
2130	FEMP Support Team en route and contacts FEMP EOC for update. FEMP EOC faxed information for the waste characterization to KFD Asst Chief.
2200	AZ Radiation Regulatory Agency (RRA) arrives at event scene. Briefed by KFD Asst Chief and set up "Unified Command". AZ RRA considered entering exclusion zone for reconnaissance but collective decision made to await arrival of DOE RAP

Team.

2250 AL RAP Team arrives on scene. Arizona Department of Public Safety Officer is the State On Scene Coordinator.

2300 AL RAP Team radiological survey of truck driver and KFD turnout gear indicated no contamination. (Used ESP with AC-3 probe for alpha and ESP with tube pancake probe for beta/gamma.)

2330 Truck and exclusion zone surveys indicated no measurable increase in background levels with both probes.

12/16/97 Tuesday

0001 RAP Team opens trailer with seal # 01681. Liquid observed near WMBs at rear of trailer. Noted strong odor inside trailer; needed more information to determine if odor is hazardous. Cordoned area to assess possible hazardous cargo.

0002 RAP Team informed by FEMP EOC that odor is normal and material was sludge.

0005 RAP Team reentered exclusion area.

0039 KFD HAZMAT Support Truck released from scene.

0108 RAP Team surveys boxes, no contamination found. Fine sand like material on floor of trailer. Unified Command, including AZ DPS, AZ RAD REG, KINGMAN AZ FD IC and RAP Team develops "plan of action" to await FEMP Support Team. Reduces exclusion zone to the perimeter of the truck.

0115 FEMP EOC decides to stand down.

0155 RAP Team leaves scene. Trailer locked and driver resumes control of trailer.

0200 FEMP EOC stood down for the night with recovery plan to return WMB to strong tight condition and drive truck to NTS. A formal written recovery plan was not completed when the FEMP EOC stood down. No change in event classification made; notification of EOC stand down made to HQ.

0208 AL EOC stood down for the night.

0300 FEMP Team arrives Las Vegas, NV. Notified by Communications Center that scene has been secured.

0530 FEMP Support Team arrives at event scene and receives up date from truck driver that at 10:00 am local time (noon EST) all parties would reconvene at event scene. Support team confirms negative radiological readings and notes trailer is still dripping fluid. Team then purchases supplies to remove shoring and blocking material.

1200 FEMP Team back at event scene.

1226 FEMP EOC downgraded event to Unusual Occurrence

1230 RAP Team, AZ DPS and KFD returns to incident scene.

1302 Shoring for shipping stability removed to inspect bottom of boxes. Inspection of the underside of the rear most box revealed a "weld fault" on the center runner.

1317 Direct frisk of the underside of the box indicated about 70 Counts per minute (cpm) above background with a GM probe and 350 cpm above background with an Ecectra probe. (Kingman background is lower than Fernald background.) These levels are below limits and pose no real indication of a radiological Hazard as determined by FEMP Support Team. No alpha contamination found.

1353 AL Rap Team turns scene over to the FEMP Team. AL-RAP Team leaves supplies for FEMP Team. FEMP Team prepares plan for field repair of leaking box.

1415 Only truck driver and FEMP Team remain at scene.

1430 AL EOC faxes final situation report.

1530 Epoxy patch applied to visible end of last box in truck (#843141).

1600 AL RAP team departs Kingman, AZ.

1630 FEMP Team inspects patch; noticed significant decrease in leak rate. Applied second coat of epoxy. Decided to let patch cure overnight. Briefed FEMP Waste Management on current status and plans. Secured trailer and release control of truck back to the driver.

FDF notified of four additional leaking boxes at NTS (total of 5 this week)

12/17/97 Wednesday

FDF forwards Mod 6 (extend runner to edge of box) to CGR.

0700 FEMP Team observes trailer still dripping fluid and inspected load. Leak in patched box had stopped. Requested support from FDF to inspect entire shipment.

0900 FEMP Team contacts NTS Ops Manager to status availability of support from NTS. FEMP Team found available local rental equipment.

1000 FEMP Team confirms availability of personnel and equipment from NTS to support recovery.

1230 Confirmation of OHM contract for Kingman Emergency Response faxed to OHM by FDF Waste Management.

1500 FEMP Team advised by FDF that OHM was to assume recovery operations. with a mobilization time of five to seven hours; pan trailer en route; and shipment was to be routed to FEMP via reverse route. Trailer secured and control returned to truck driver.

12/18/97 Thursday

0800 FEMP Team meets OHM at lodging to discuss recovery plan.

0900 Entourage assembles at scene and takes control of trailer. Repacking started.

1100 Pan trailer arrives with bad gasket; replacement gasket ordered from Tri- State.

12/19/97 Friday

0300 OHM completes loading pan trailer. Trailer locked, weighed, and parked in Petro lot. Recovery team stand down for the night.

1100 Recovery team returns to trailer, verified site left clean in the daylight, reconfirmed negative radiological readings and completed shipping documents received from FDF traffic management.

1700 Gasket for pan trailer arrives and is installed. Driver briefed by FEMP Team on shipping papers. Sealed trailer door.

1730 Truck departs for FEMP , OHM completes demobilization and FEMP Team departs for Las Vegas.

12/21/97 Sunday

0310 Truck arrives at FEMP.

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APPENDIX C

Notifications Made Regarding the Leaking Waste Containers at Kingman, Arizona

Notification Made By:	Notification Made To:	Date and Time of Notification (Eastern Standard Time)	Requirement for Notification
Trism Truck Driver	Trism/TriState Emergency Contact Number	12/15/97 1630	Trism/Tri-State Emergency Procedure
Trism Truck Driver	Mojave County 911	12/15/97 ~1645	Trism/Tri-State Emergency Procedure and FEMP Shipping Papers
Trism Truck Driver	FEMP 24hr Emergency Number/FDF AEDO	12/15/97 1654	FEMP Shipping Papers and FEMP Transportation Emergency Plan
FDF AEDO	FDF EDO	12/15/97 1705	FEMP Transportation Emergency Plan (Operational Emergency)
FDF Comm. Ctr.	Emergency Response Organization Group Page	12/15/97 1708	FEMP Emergency Plan
FDF AEDO	HQ'S EOC Watch Office	12/15/97 1715	FEMP Emergency Plan
Trism Emergency Duty Officer	US EPA National Response Center	12/15/97 ~1705	Trism/Tri-State Emergency Response Procedure
Trism Emergency Duty Officer	AZ Radiation Regulatory Authorities	12/15/97 ~1715	Trism/Tri-State Emergency Response Procedure
Mojave County Sheriff's Department (On Scene)	Kingman Fire Dept. Hazmat Chief	12/15/97/ 1720	Kingman FD is nearest HAZMAT response to I-40/Exit 66
FEMP EOC	Kingman On Scene Incident Command	12/15/97 1750	FEMP Transportation Emergency Plan
FEMP EOC (DOE Liaison)	DOE HQ EOC (DP-23) RAP Team Asst. Req	12/15/97 1804	FEMP Transportation Emergency Plan/Event Driven

Notification Made By:	Notification Made To:	Date and Time of Notification (Eastern Standard Time)	Requirement for Notification
HQ's EOC/DP-23	DOE AL Duty Officer & SNL RAP Team CPT	12/15/97 1813	RAP Regional Plans (AZ is in Region 4/AL)
RAP Team	State of Arizona Regulatory Authorities	12/15/97 1827	RAP Regional Procedures/Request confirmation & authority to proceed to Kingman, AZ
FEMP EOC	Secretary of Energy, DOE EM-1, DOE-OH, OH-EPA, Local Stakeholders	12/15/97 All made by ~1855	Significant Event driven, Secretary memorandum for "*Timely Notification of Emergencies and Significant Events*"
FEMP EOC	NTS Operations (Request for data on shipments en route)	12/15/97 ~2100	Event Driven

APPENDIX D
Documents and References

1. Fact Sheets 1997-0056 for Off-normal Occurrences of Leaking White Metal Boxes (WMB) and first update

2. Procedures

PT-0007	Packaging Low-Level Radioactive Waste (LLRW) in Metal Boxes for Shipment, Rev. 4, Effective 8/7/97
PT-0011	Evaluating Low-Level Radioactive Waste (LLRW) Streams for Shipment to the Nevada Test Site (NTS)
QA-0005	Inspection of Procured Material, Equipment, Work in Process and Low Level Waste Project Training and Qualification Program Description, Rev. 0, Effective 10/31/97

3. FERMCO (FDF) Subcontract 95MB004830 and Modifications 1-6

4. Material Evaluation Forms (MEFs)

5. WMB Shipment Video (171509 is last on video)

6. Summaries of Interviews conducted by D. Kozlowski of operators on 12/23/97.

7. CGR Internal QC Work Inspection Orders Dated 9/5/95 and 3/22/97

8. Waste Management Organizational Charts (10/1/97 and 1/1/98)

9. Shipping Records for 4 Shipments (pre/post loading) 98-018, 98-021, 98-025, 98- 052

10. Memo from Alm to Distribution on Suspension of Low-Level Waste Shipments via "White Boxes" Pending Fernald Investigation, Dated 12/29/97

11. CGR Pre-Award Surveillance

12. Nevada Test Site Waste Acceptance Criteria

13. Memo Informal Note to The Secretary from Al Alm, dated 12/23/97, "Shipping Incident En Route to Nevada Test Site"

14. Shipping Records for 3 additional shipments (09-013, 98-023, 98-051)

15. All FDF/CGR Correspondence beginning 1995 (received through 12/16/97)

16. Original Solicitation (Request for Proposal)

17. Specification Changes Chronology of FDF Purchase Order 95MB004830 (Draft)

18. DOE Letter December 23, 2997 to John Sattler from Runore Wycoff. Doe-NV, Transmittal of Corrective Action Requests (CARs) Issued as a Result of the Waste Stream ONLO-000000006 Leaking Boxes Identified During the Week of December 15, 1997

19. AEDO Daily Event Log for 10/6/97

20. FDF Nonconformance Report Form 97-0138, Discovered 5/20/97, NTS

21. CGR NVO-325 Strength Test, C-95 (Full Height) Container (for Mods 5&6)

22. Video - White Metal Box Investigation Team Dub

23. Photographs 6788-223-297 taken 1/7/98 during inspection of second Kingman leaking box

24. Correspondence on Prior FEMP Leaking Boxes (beginning 1991)

25. Occurrence Reports on Leaking Boxes

26. DOE-FEMP Transportation Emergency Plan, PL-3043

27. CGR Welding Program and Certificates

28. Dicalite specs (barely readable - requested better copy, received 1/21/98) Water Works specs Quik-Solid specs

29. MSDS numbers 10072 (Dicalite Speed Plus) and 12217 (Dicalite)

30. Record of Independent Review (Procurement Document)

31. Memorandum dated 12/24/97, Straka to Ives, "Region 4 Deployment to Kingman, Arizona, on December 15, 1997"

32. Quality Evaluation Plans, QA Procedure QP-7.06, Rev. 3, Effective 8/15/97

33. FERMCO (FDF) letter, E. Straub to B.R. Lyons, dated 4/26/97, "FERMCO REQUEST FOR PROPOSAL (RFP) NO. F95P16697, AMENDMENT NO. 1"

34. DOE Letter Parsons to Green, DOE-1035-97, dated 6/27/97, "Evaluation of 97-2 Performance Objective Criteria 1.G"

35. DOE Letter Craig to Bradburne, DOE-0625-97, dated 3/14/97, "DOE Order 5480.19 "Conduct of Operations at Department of Energy Facilities" Performance-Based Assessment Results"

36. Chronology for Shipment 97-207

37. Chronology for Shipment 97-327

38. Information on CGR shipments after 5/21/97 - 112

39. CGR Purchases by drawing and description

40. Memorandum to John Sattler from Runore Wycoff, dated 12/8/97, Transmittal of DOE/NV Radioactive Waste Management Program Audit Report

41. Record of Independent Review for CGR Compacting, 95MB004830

42. CGR Pre-Award Surveillance

43. Videotapes CGR testing C-95 and C-9512, 6/28/95 (53 minutes and 100 minutes)

44. Sandia National Laboratories' Analysis of Waste Box 483141 (via fax)

45. Chronology for Shipment 98-052 (Kingman)

46. Surveillance Report "Assessment of the Operation of the RTR System, Surveillance No. 98-0021, dated 1/14/98

47. FDF Nonconformance Reports 8/95 to 12/96

48. CGR drawing, box 1/2 height specs

49. ASTM Designation: D 4359 - 90 Standard test Method for Determining Whether a Material is a Liquid or a Solid

50. Bechtel Letter Sygitowicz to Dever, dated 6/3/97, Notice of Discrepancy Regarding Incoming Waste Shipment Number WML97207 Fernald Environmental Management Project (Project No. 04046)

51. Shipping Order for Nuclear Material WML 97327

52. Shipping Order for Nuclear Material WML 97207

53. Paint Filter Liquids Test (method used to determine compliance with 40CFR264.314 and 265.314.

54. Method 9096 - Liquid Release Test (LRT) Procedure

55. Waste Acceptance Overview Checklist (10 performed prior to 12/23/97 Letter with nonconformance to Sattler, 1 performed 1/14/98)

56. Justification for Award - Procurement of Strong-Tight Metal Shipping Containers

57. CGR Correspondence for 1995

58. Kingman AZ liquid lab results

59. Standing Water Samples - Shaking Test Results

60. Sandia National Laboratories Memorandum "Request for Clarification and Additional Information" with attachments, dated 1/22/98

61. FDF Letter C:WMMTP:98-001, Paine to Kozlowski, dated 1/21/98, Comments on Draft DOE Type B Investigation Team Report

62. Paint Filter Liquids Test (Method 6527)

63. Fax from Paul Liebendorfer - Comments on Type B Factual Draft

64. Chronological History of Fernald Environmental Management Project Shipments of Leaking Waste Packages

APPENDIX E

Individuals Interviewed for Type B Investigation by Position

Fluor Daniel Fernald Waste Operations Staff

1. Supervisor of Loading Trucks
2. Hazardous Waste Technician (HAZWAT) 1
3. HAZWAT 2
4. HAZWAT 3
5. Waste Characterization Team Coach
6. HAZWAT 4
7. HAZWAT 5
8. Motor Vehicle Operator (MVO) 1
9. HAZWAT 6
10. MVO 2 and HAZWAT 7
11. Low Level Waste Shipping Team Leader and Low Level Waste Team Leader
12. Waste Acceptance Manager, Waste Acceptance Officer for Nevada Test Site (NTS)
13. Low Level Waste Operations Team Coach
14. Area Supervisor of Low Level Waste Shipping and Team Leader Low Level Waste Waste Technicians
15. Program Coach for Waste Services and Waste Management Technology Programs
16. Traffic Management, Low Level Waste (LLW) Group
17. Low Level Waste Team Coach
18. Quality Assurance (QA), Team Technical Specialist, Waste Management Technology Division
19. Alternate Waste Certification Official
20. Traffic Manager, Traffic Section of Waste Services
21. Waste Acceptance Manager, Waste Acceptance Officer for NTS
22. QA Manager in Waste Management and Technology Division
23. Project Engineer for LLW
24. Alternate Waste Certification Official
25. Technical Representative on WMB and LLW Project Engineer
26. QA Team Technical Representative, works Real Time Radiography (RTR)
27. FDF Engineering Team Coach for Technical Section
28. Low Level Waste Operations Team Coach
29. Rad Engineer for Mixed Waste
30. Low Level Waste Project Manager
31. Traffic Manager of Traffic Section
32. Traffic Management, Low Level Waste Group
33. Vice President for Waste Management and Technology
34. Waste Management Technology Program Coach

Fluor Daniel Fernald Procurement and Acquisitions Staff

35. Acquisition Manager matrixed to the Waste Management and Technology Silos Project
36. Contract Administrator responsible for placement of White Metal Box order and administered it through 2/97
37. Procurement Buyer
38. Cost Account Manager for Low Level Waste

Fluor Daniel Fernald Emergency Operations Staff

39. Emergency Preparedness Manager
40. Deputy Emergency Director, Emergency Duty Officer
41. Team Technical Specialist
42. Site Utility Engineer Assistant Emergency Duty Officer

DOE-FEMP Staff

43. DOE Deputy Assoc. Director for Safety and Assessment
44. DOE Waste Management Team Leader
45. DOE Facility Representative
46. DOE Director
47. DOE Facility Representative
48. DOE Project Manager
49. DOE Environmental Engineer
50. DOE Program Analyst

Other DOE Staff

51. DOE Contract Officer
52. DOE Contracts Team Leader (Telephone)
53. DOE EH Site Representatives (Telephone)
54. DOE Project Manager for Waste Operations and Technical Lead for LLW Disposal, and Waste Operations LLW Project Manager (Telephone)
55. DOE Contracts Team Leader (Telephone)
56. Sandia National Laboratory (Telephone)

Out of Area Participants

57. Assistant Chief, Kingman Fire Department (Telephone)
58. Arizona Department of Environmental Quality (Telephone)
59. Arizona Department of Public Safety Officer (Telephone)
60. Tri-State Motor Carrier (Telephone)

APPENDIX F

Summary Events And Causal Factors

EXHIBITS